

SUPPORT FOR THE AMENDMENTS

Claims 1-13, 17, 20, 23 and 25 are canceled. Claims 1-13, 17 and 20 were previously canceled. Claims 23 and 25 are herein canceled.

Support for the amendment to Claim 14 is found on page 8, line 9 (amount of metal), page 9, line 16 (uniformly dispersed), page 11, last line (JIS K 5600-5-4), Tables 3 and 5 (6H pencil and acid washing).

No new matter will be added to this application by entry of this amendment.

Upon entry of this amendment, Claims 14-16, 18, 19, 21, 22, 24 and 26 are active.

REMARKS/ARGUMENTS

The claimed invention is directed to a quartz glass crucible for the preparation of silicon single crystal via a process wherein the silicon single crystal is pulled up from molten silicon in the crucible. A crucible providing for a high dislocation free ratio of the pulled crystal while having a durable functional surface, which can be washed with water and/or acid and is not abraded upon handling is sought.

The claimed invention addresses this problem by providing a quartz glass crucible comprising an inside surface and an outside surface, wherein, at least the inside surface comprises a transparent coated layer consisting essentially of a crystallization promoter uniformly dispersed in a silica matrix, wherein, said crystallization promoter is a metal oxide derived from a metal organic acid salt or a metal carbonate of one or more metals selected from the group consisting of magnesium, calcium, strontium and barium; an amount of said crystallization promoter is equal to or more than 1×10^{-9} to less than or equal to 1×10^{-6} mol/cm² being calculated as metal oxide; the transparent coated layer has a mechanical strength measured by JIS K 5600-5-4 wherein the coated layer is not scratched by a pencil of 6H hardness; and the amount of said crystallization promoter uniformly dispersed in the silica

matrix does not change upon acid washing of the quartz glass crucible. No such quartz glass crucible is disclosed or suggested in the cited references.

Applicants wish to thank Examiner Song for the courteous and useful discussion of the above-identified application with Applicants' U.S. representative on February 7, 2008. At that time, Applicants' U.S. representative discussed possible claim amendments and reviewed the combination of cited references. Examiner Song explained that Watanabe is cited to show improvement of Hansen and that only Watanabe's description of the formation of an inner layer of crystallization promoter is combined with the primary reference in support of the rejection. Examiner Song expressed the opinion that Watanabe describes steps in the cited method to form a crucible and the rejection is therefore based on only an isolated step. The discussion which follows reiterates and expands upon that discussion.

The rejection of Claims 14-16, 18-19 and 21-26 under 35 U.S.C. 103(a) over Hansen et al. (U.S. 5,980,629) in view of Watanabe et al. (U.S. 6,106,610) is respectfully traversed.

The combined references neither disclose nor suggest the quartz glass crucible as presently described in Claim 14 of the present invention.

Applicants respectfully note that Claim 14 is herein amended to include the description:

“at least the inside surface comprises a transparent coated layer **consisting essentially of** a crystallization promoter **uniformly** dispersed in a silica matrix”

and

“the transparent coated layer has a mechanical strength measured by JIS K 5600-5-4 wherein the **coated layer is not scratched by a pencil of 6H hardness**; and

the amount of said crystallization promoter uniformly dispersed in the silica matrix **does not change upon acid washing of the quartz glass crucible.**”

Hansen is directed to a process for preparing a silicon melt for pulling a single crystal by the Czochralski method comprising loading granular polycrystalline silicon into a crucible of vitreous silica having a bottom wall and a sidewall formation extending up from the bottom wall and defining a cavity for holding the molten semiconductor material, with a first devitrification promoter being on the inner surface of the sidewall formation (Claim 1, in part). The first devitrification promoter is deposited on the inner surface of the crucible sidewall formation at a temperature below 600°C (Col. 2, lines 65-67). This deposit is such that, during “the Czochralski process, in general, and the melting of the polysilicon, in particular, stable crystal seed nuclei form at these nucleation sites and the vitreous silica at the crucible surface crystallizes, . . .”(Col.4, lines 21-25).

Applicants have described the problems associated with a crucible treated in the conventional manner as described by Hansen, beginning on page 1, last paragraph and bridging to page 2. Since the devitrification promoter is not fixed on the quartz glass crucible, the adhesion strength of that layer is very weak and the devitrification promoter powder is easily abraded and falls off during handling. The crucible cannot be washed because the devitrification powder would be removed in this process. As a result of handling and possible cleaning, the amount of devitrification promoter adhering to the crucible surface becomes nonuniform across the surface and nucleation efficiency is degraded. Hansen actually describes removal of the devitrification promoter from the inner bottom surface of the crucible by a acid washing process (Col. 8, lines2-5).

The Office has cited Watanabe to show a method of forming a crystallization promoter layer by dispersing the promoter in a silica matrix. Applicants’ previous arguments that Watanabe teaches away from Hansen because Watanabe requires the crystallization promoter not be at the surface of the crucible in contact with the melted polysilicon has not been accepted by the Office. The Office’s response is: “Watanabe is merely relied upon to

teach an improved method of forming a crystallization promoter layer by dispersing the promoter in a silica matrix.” On the other hand, the Office has stated: “Hansen is relied upon to teach an crystallization promoter containing inner layer which is in direct contact with a polysilicon material . . .” The logic of this reasoning is not understood by Applicants.

Hansen **requires** a layer of crystallization promoter **in direct contact with melted polysilicon** and Watanabe requires the crystallization promoter **not be in direct contact with the melted polysilicon**. The cited references clearly teach opposite requirements and therefore Applicants respectfully submit that one cannot be an improvement of the other.

Applicants respectfully disagree with the Office’s position that the rejection can be supported as an improvement of the Hansen crucible by combining with only a part of the Watanabe disclosure.

The MPEP § 2143 C, under the heading “Use of Known Technique To Improve Similar Devices (Methods, or Products) in the Same Way” states:

“To reject a claim based on this rationale, Office personnel must resolve the Graham factual inquiries. Then, Office personnel must articulate the following:

(1) a finding that the prior art contained a “base” device (method, or product) upon which the claimed invention can be seen as an “improvement;”

(2) a finding that the prior art contained a “comparable” device (method, or product that is not the same as the base device) **that has been improved in the same way as the claimed invention;**

(3) a finding that **one of ordinary skill in the art could have applied the known “improvement” technique in the same way to the “base” device** (method, or product) and the results would have been predictable to one of ordinary skill in the art; . . .” (Bold added)

Applicants respectfully submit that the Watanabe crucible is described in Col. 6, lines 25-33, as follows:

“Thus , because the impurity which functions as the crystallization promoter is not brought into contact with the silicon melt, the incorporation of an impurity into the silicon single crystal can be prevented from occurring. Accordingly, the present invention is also effective in suppressing the generation of crystal defects.”

Applicants respectfully submit that Watanabe neither discloses nor suggests improvement by forming an inner layer of the crucible wherein the crystallization promoter is uniformly dispersed in a silica matrix as described in Claim 14. Moreover, Applicants respectfully submit that as the reference clearly describes that the crystallization promoter should not be in contact with the silicon melt, **it would not have been obvious** to one of ordinary skill in the art to apply the description of a non-exposed inner crystallization promoter layer of Watanabe to the surface layer of Hansen.

MPEP § 2143 (G) states that to reject a claim based on a combination of references to arrive at the claimed invention, Office personnel must articulate:

“(1) a finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings; . . .”

Moreover, as described above, Hansen, in a preferred embodiment, relies upon the removal of the crystallization promoter by an acid wash process. Such a process would not be possible if the promoter is in a silica matrix layer covered from surface exposure by another silica matrix layer according to Watanabe. Applicants respectfully maintain that the two references describe opposing technology and therefore cannot be combined.

Furthermore, Applicants respectfully submit that Watanabe neither discloses, suggests or provides motivation to isolate the crucible after application of the crystal promoter to the base body as the Office has suggested. According to the description in Col. 5, lines 8-26, the Watanabe crucible is not removed from the apparatus of Fig. 1 until formation, including the covering inner layer is complete.

The presently claimed invention includes the description:

“at least the inside surface comprises a transparent coated layer **consisting essentially of** a crystallization promoter **uniformly** dispersed in a silica matrix”

and

“the transparent coated layer has a mechanical strength measured by JIS K 5600-5-4 wherein the **coated layer is not scratched by a pencil of 6H hardness**; and

the amount of said crystallization promoter uniformly dispersed in the silica matrix **does not change upon acid washing of the quartz glass crucible.**”

Applicants herein submit a copy of JIS K 5600-5-4 (Japanese and English).

In view of the foregoing, Applicants respectfully submit that Hansen is deficient with respect to each of the amendment descriptions and Watanabe does not cure the deficiency.

Applicants respectfully call the Examiner’s attention to the following excerpt from the MPEP § 2143.01 IV. in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*

“[R]ejections on obviousness cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” KSR, 550 U.S. at _____, 82 USPQ2d at 1396 quoting *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006).

Applicants respectfully submit that based on the foregoing, and according to the KSR guidelines, a conclusion of obviousness over the combination of Hansen and Watanabe cannot be supported.

Furthermore, Applicants herein submit further evidence of significant improvement in the quartz glass crucible of the presently claimed invention as described in the attached declaration of Mr. Yoshiyuki Tsuji, a named inventor in this application. Mr. Tsuji has been employed by Mitsubishi Material Quartz Corporation for 16 years. As shown by the attached partial copy entitled “Certification of all Closed Matters,” the company name was changed to Japan Super Quartz Corporation on February 1, 2002.

As indicated in the modified Table 2 and the supporting calculations, the thickness of the modified surface of the claimed crucible is smaller by at least a factor of 400. As a result,

the crucible of the present application has an extremely thin surface layer of crystallization promoter uniformly dispersed in a silica matrix, which is durable in handling and storage, can be acid and water washed, has a high resistance for deformation during the pulling-up process and allows for less contamination to the melted silicon in comparison to conventional crucibles as described by the cited references.

Moreover, Applicants respectfully submit that one skilled in the art would recognize that such a thin layer, i.e., less than 1 μm would not be obtained by the Watanabe process since the coating of the SiO_2 -metal oxide mixed layer is done by arc plasma scattering at a temperature of 1800°C (Col. 2, lines 34-46). At such a high temperature, the diffusion rate is so fast that such a thin layer would rapidly diffuse, and as a consequence, obtaining the structure of the claimed invention would not be possible.

Based on the foregoing, Applicants respectfully submit that the cited references neither anticipate, render obvious nor suggest the significant improvement according to the presently claimed invention. Withdrawal of the rejection of Claims 14-16, 18-19 and 21-26 under 35 U.S.C. 103(a) over Hansen et al. in view of Watanabe et al. is respectfully requested.

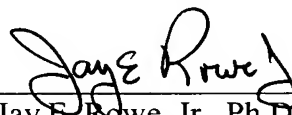
The rejection of Claims 14-16, 18-19 and 21-26 under 35 U.S.C. 112, first paragraph, is obviated by appropriate amendment. Claim 14 is herein amended to describe the range of equal to or more than 1×10^{-9} to less than or equal to 1×10^{-6} mol/cm^2 being calculated as metal oxide; which is supported on page 8, line 9, in the specification. In view of the amendment the rejection is believed moot and withdrawal of the rejection of Claims 14-16, 18-19 and 21-26 under 35 U.S.C. 112, first paragraph, is respectfully requested.

The rejection of Claim 25 under 35 U.S.C. 112, second paragraph is moot in view of the cancellation of Claim 25 herein.

Applicants respectfully submit that the above-identified application is now in condition for allowance and early notice of such action is earnestly solicited.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
Norman F. Oblon

A handwritten signature in black ink, appearing to read "Jay E. Rowe, Jr.", is written over a horizontal line.

Jay E. Rowe, Jr., Ph.D.
Registration No. 58,948

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/07)